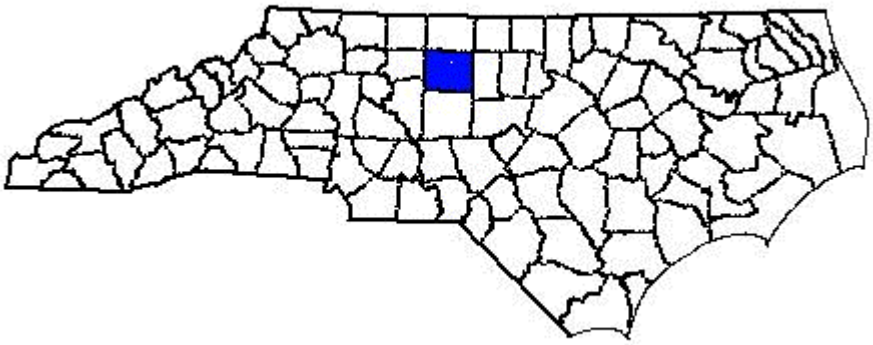
ANNUAL REPORT FOR 2000



South Buffalo Creek Mitigation Site

Guilford County

Project No. 8.U493501

TIP No. I-2402 WM

Prepared By:
Natural Systems Unit & Roadside Environmental Unit
North Carolina Department of Transportation
December 2000

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SUMMARY

The following report summaries the monitoring activities that have occurred in 2000 at the South Buffalo Creek Mitigation Site, representing the second year of hydrologic monitoring. Vegetation monitoring began in 1999 but was restarted with the additional requirement of monitoring the existing preservation area, therefore, 2000 represents the first year of vegetation monitoring.

The site is equipped with seven groundwater-monitoring gauges, 2 surface gauges, and 1 rain gauge that were installed in July 2000. Rainfall data from the State Climatic Office for Greensboro was substituted for the on-site rainfall data, since the rain gauge (automatic recording tipping bucket) was installed during the middle of the growing season.

Hydrologic monitoring resulted in six of the seven monitoring gauges recording the groundwater within 12 inches of the soil surface for more than 12.5 % of the growing season. After a field inspection, it is unknown why one gauge did not meet hydrology. Monitoring Gauge, G10, the only groundwater gauge that did not record sufficient hydrology to meet the 12.5% hydrology requirement, appears to be placed in a wetland surrounded by obligate wetland plants.

Three vegetation-monitoring plots are located within the planted corridor, where the impervious subsurface wall was installed. These sites met the vegetation success criteria in 2000 with an average density of 524 trees per acre. In addition in 2000, monitoring of the existing forested area was conducted to demonstrate that wet-tolerant trees would show a lack of a negative impact from the increased water levels as a result of the impervious subsurface wall installed to increase hydrology.

Based on monitoring results of 2000, NCDOT recommends that monitoring continue. Gauge location and elevation will be surveyed in 2001 to facilitate correlation of surface and groundwater data on the site for future monitoring activities.

1.0 INTRODUCTION

1.1 Project Description

The South Buffalo Creek Mitigation Site is located in Guilford County west of the NC 6 interchange with I-85 on the southeast side of Greensboro (Figure 1). Approximately 58 acres in size, the site serves as compensatory mitigation for several highway projects, including the eastern Greensboro Bypass (I-2402), the Northeastern Urban Loop (U-2525) and the widening of I-40 (I-2201 F/E). Site construction involved the installation of a subsurface impervious wall to retard groundwater flow in support of swamp and bottomland hardwood forests communities.

1.2 Purpose

In order to demonstrate successful mitigation, the South Buffalo Creek mitigation site is monitored for both hydrologic and vegetation restoration success as established in the mitigation plan. The site was first monitored in 1999. The following list depicts the history of the South Buffalo Creek Mitigation Site since implementation.

1.3 Project History

August – December 1998	Site Construction
February 1999	Site Planted
March – November 1999	Hydrologic Monitoring (1st year)
August 1999	Vegetation Monitoring – (1st year)
March – November 2000	Hydrologic Monitoring (2nd year)
July 19, 2000	Infinities Rain Gauge Installed
February 2000	2 - 40” Groundwater Gauges Installed
November 2000	Existing forested area monitored (1st year)
November 2000	Vegetation Monitoring (1st year - restarted)

2.0 HYDROLOGY

2.1 Success Criteria

In accordance with federal guidelines for wetland mitigation, the success criteria for hydrology states that the area must be inundated or saturated (within 12" of the surface) by surface or ground water for a consecutive 12.5% of the growing season. Areas inundated less than 5% of the growing season are always classified as non-wetlands. Areas inundated between 5% - 12.5% of the growing season can be classified as wetlands depending upon factors such as the presence of hydrophytic vegetation and hydric soils.

The growing season in Guilford County begins March 26 and lasts until November 6. These dates correspond to a 50% probability that air temperature will drop to 28° F lower after March 26 and before November 6.[1] Thus the growing season is 224 days; optimum hydrology requires 12.5% of this season, or 28 days. Local climate must represent average conditions for the area.

2.2 Monitoring Methodology

Four groundwater monitoring gauges, two surface gauges, and one rain gauge were installed in winter 1998 after site construction (Figure 2). An additional groundwater gauge was installed in early May 1999 and two 40-inch groundwater gauges were installed in February 2000. An Infinity rain gauge replaced the original rain gauge in July 2000. Daily readings were taken throughout the growing season.

Appendix A contains a plot of the water depth for each groundwater monitoring gauge and surface gauge. Monitoring results are shown from March 26 to November 6. Daily precipitation data from a local site in Greensboro is provided on each graph.

2.3 Results of Hydrologic Monitoring

2.3.1 Site Data

The maximum number of consecutive days that the groundwater was within twelve inches of the surface was determined for each gauge. This number was

[1] Soil Conservation Service, Soil Survey of New Hanover County, North Carolina, 1977.

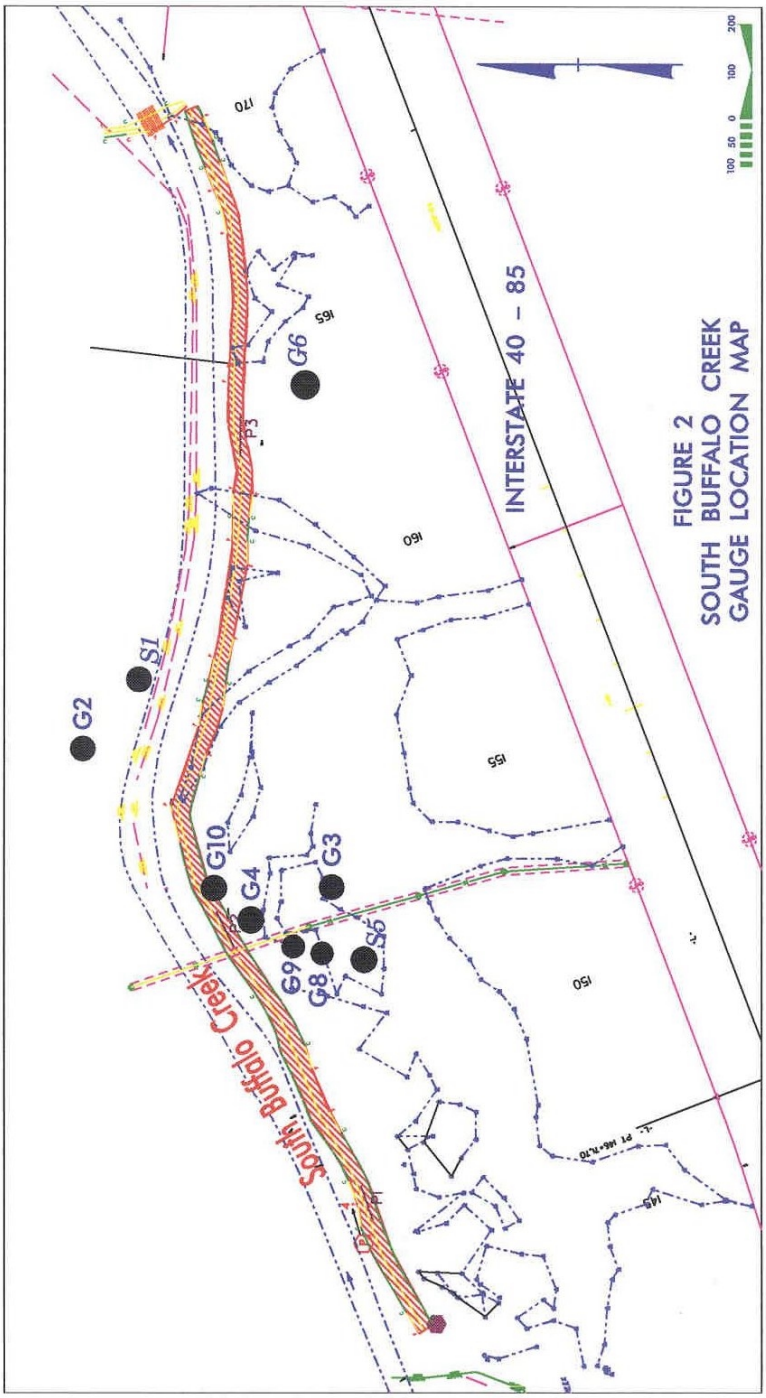


Figure 2. Monitoring Gauge Location Map

converted into a percentage of the 224-day growing season. Because it is uncertain if all wetlands impacted by NCDOT highway projects meet the 12.5% criteria, the monitoring gauge results are segmented into percentage ranges. Table 1 presents the monitoring results for the 2000 growing season as a range of percentages, actual percentages, and success dates of the longest hydroperiod on the site. Figure 3 depicts the location and hydrologic monitoring results of the groundwater gauges.

Table 1. HYDROLOGIC MONITORING RESULTS

Groundwater Gauge	**< 5%**	**5% - 8%**	**8% - 12.5%**	**> 12.5%**	**Actual %**	Dates
G2 (reference)				✔	31.7	Aug 28-Nov 6
G3				✔	21	Mar 26-May 11
G4				✔	12.9	Mar 26-Apr23
G6				✔	20.5	Mar 26-May 10
G8				✔	21.9	Mar 26-May 13
G9				✔	20.5	Mar 26-May 10
G10			✔		10.3	Apr 16-May 8, Sep 16-Oct 8

Since precipitation data for 2000 was fairly typical to low with one month of disproportionate precipitation (September), all data collected during the growing season were considered to determine hydrologic success of the site. Five of six gauges on the mitigation site recorded the water table within 12 inches of the surface for more than 12.5% of the growing season. In addition, the reference gauge, G2, also recorded the water table for greater than 12 inches of the surface for more than 12.5% of the growing season. The five groundwater gauges and one reference gauge all met hydrologic criteria early during the growing season so that if the above average rainfall from September (3.71 inches on September 15) were discounted, these sites would have still met hydrologic criteria. In addition, G2, G3 and G8 again met hydrologic conditions partially facilitated by the precipitation of several inches of rain that fell in mid-September.

Variation in mircotopography is present throughout the wetland mitigation site and some areas such as that represented by G4 appear to be on a hummock. G8 was installed to represent the lower elevations in this area.

Surface water gauges indicated a consistent presence of surface water throughout the growing season with the reference gauge, S1 being inundated for most of the season except for a couple of weeks in June. The surface gauge, S5 was also inundated for the majority of the growing season, and was slightly drier than the area represented by S1.

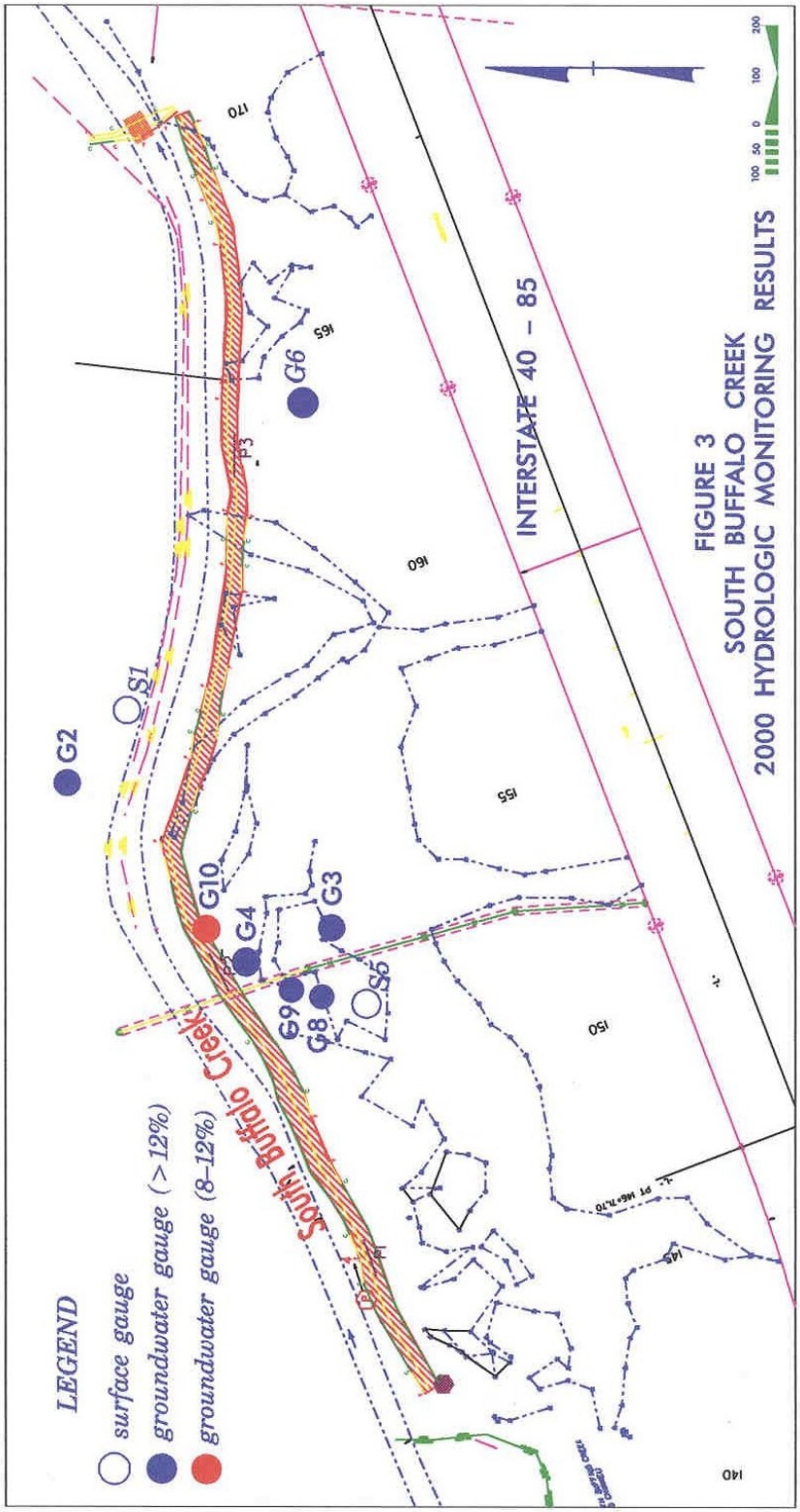


Figure 3. Hydrologic Monitoring Results

2.3.2 Climatic Data

Figure 4 represents an examination of the local rainfall in comparison with historical data to determine if 2000 rainfall occurs within the average rainfall range of the area. The historical data was provided by the National Climatic Data Center; the recent rainfall data was provided by the State Climate Office at NC State University.

Precipitation for the Greensboro area ranged from low to typical during January through August with precipitation slightly above normal in April. September rainfall was well above normal, while October (which recorded no precipitation) and November received less than average precipitation.

2.4 Conclusions

Overall, rainfall was within the normal range during most months for the majority of the growing season. Five of six gauges as well as the reference gauge met hydrologic success criteria. During field inspection, G4 appeared to be located on a slight hummock, however met hydrological requirements with 29 days. Gauge G10 appeared to be in a low wetland area, near the subsurface wall however this gauge did not respond to almost two inches of precipitation that occurred on August 28. There was no record of battery failure or explanation for this anomaly. Monitoring data from G10 should be reviewed carefully during 2001 and if necessary, an additional gauge should be installed to replace G10. Since gauges are installed in both the hummocks and depressions, surveying elevations of the gauges will provide a better indication of the site hydrology. This will be pursued as part of future monitoring activities in 2001.

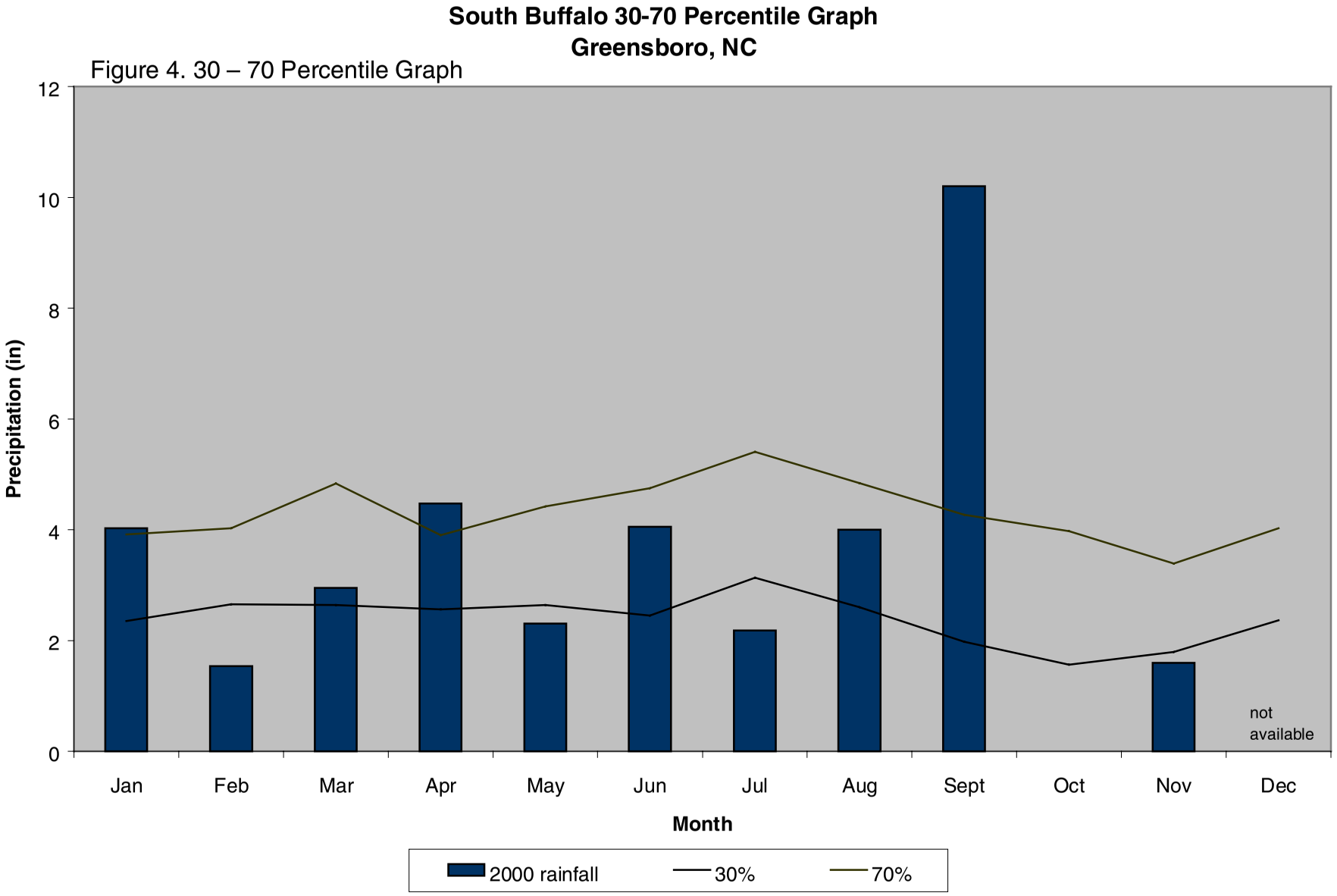


Figure 4. 30 – 70 Percentile Graph

3.0 VEGETATION: (YEAR 1 OF 5)

3.1 Success Criteria

Success Criteria states that within the planted corridor, where the impervious subsurface wall was installed, there must be a minimum mean density of 320 trees per acre of approved target species surviving for the first three years. The required survival criterion will decrease by 10% per year after the third year of vegetation monitoring (i.e., for an expected 290 stems per acre for year 4, and 260 stems per acre for year 5).

Success Criteria for the existing forested areas of the mitigation site will depend on the lack of a negative effect to the randomly selected trees in the restoration and preservation areas of the site. The existing forested sections of the site will be successful if 75% of the monitored wet-tolerant trees show a lack of a negative impact from the increased water levels.

Figure 5 depicts the vegetation monitoring plot locations and photo points with site photos included in Appendix B.

3.2 Description of Species

The following tree species were planted in the Wetland Restoration Area:

Fraxinus pennsylvanica, green ash
Platanus occidentalis, sycamore
Quercus lyrata, overcup oak
Quercus michauxii, swamp chestnut oak
Quercus phellos, willow oak
Quercus falcata var. pagodaefolia, cherrybark oak

The following trees were marked in the existing forested Wetland Preservation and Restoration Areas of the site:

Liriodendron tulipifera, tulip poplar
Fraxinus occidentalis, green ash
Ulmus americana, American elm
Quercus phellos, willow oak
Acer rubrum, red maple
Quercus michauxii, swamp chestnut oak
Carya ovata, shagbark hickory
Liquidambar styraciflua, sweetgum
Acer saccharum, sugar maple
Fagus grandifolia, beech
Ulmus alata, winged elm
Diospyros virginiana, persimmon
Quercus lyrata, overcup oak
Quercus stellata, post oak

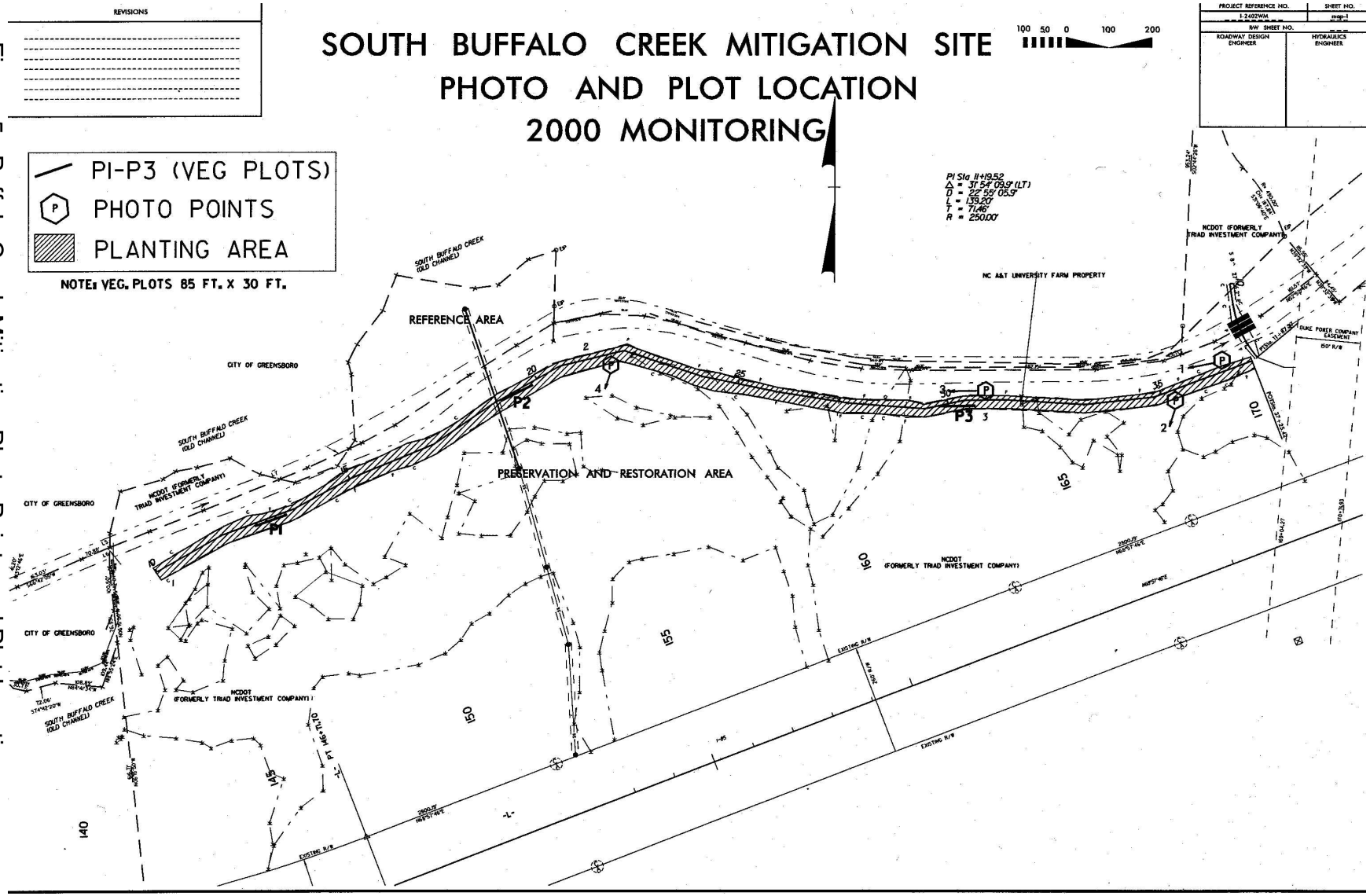


Figure 5. Buffalo Creek Mitigation Photo Points and Plot Locations

The following trees were marked in the existing forested Wetland Reference Area of the site:

Fraxinus pennsylvanica, green ash
Betula nigra, river birch
Platanus occidentalis, sycamore
Ulmus americana, American elm
Salix nigra, black willow
Ostrya caroliniana, ironwood

3.3 Results of Vegetation Monitoring

Table 2. Vegetation Monitoring Results

Plot #	Green Ash	Sycamore	Overcup Oak	Swp Chestnut Oak	Willow Oak	Cherrybark Oak	Total (1 year)	Total (at planting)	Density (Tree/Acre)
1	13	2	3			17	35	41	**580**
2	11	17	2			1	31	45	**468**
3	11	9	2		1	5	28	36	**529**
			AVERAGE DENSITY						**524**

Site Notes: Other species noted: box elder (*Acer negundo*), black willow (*Salix nigra*), *sweetgum (Liquidambar styraciflua*), bitternut hickory (*Carya cordiformis),* red maple (*Acer rubrum),* southern sugar maple (*Acer barbatum*), volunteer green ash (*Fraxinus pennsylvanica*), elderberry *(Sambucus canadensis*), pokeberry (*Phytolacca americana*), aster (*Aster* spp), goldenrod (*Solidago* spp), blackberry (*Rubus argutus*), cattails (*Typha latifolia*), dock (*Rumex* sp), rushes (*Juncus* spp), sedges (*Carex* sp), woolgrass (*Scirpus cyperinus),* fescue (*Festuca* sp), Japanese grass (*Microstegium vimineum*) and other various grasses. The site was monitored after leaf drop thus making trees difficult to find. Natural regeneration is evident on site.

Table 3 contains measurements (DBH) of fifty trees that were tagged in the Reference (#1-10) and Restoration and Preservation Areas (#11-50).

Table 3. Randomly Selected Trees in the Restoration and Preservation Area

#	Species	DBH	#	Species	DBH
1	Green Ash	4.2	26	Sugar Maple	8.7
2	Green Ash	2.4	27	American Elm	8.7
3	River Birch	6.2	28	American Elm	14.7
4	Sycamore	8.7	29	Green Ash	8.4
5	Am. Elm	11.1	30	American Elm	11.2
6	Sycamore	12.2	31	Green Ash	14
7	Black Willow	7.2	32	Green Ash	7.6
8	American Elm	14.6	33	Beech	10.8
9	American Elm	7.5	34	Beech	5.2
10	Ironwood	5.6	35	Swp. Chestnut Oak	6
11	Tulip Poplar	4.32	36	Beech	7.3
12	Green Ash	6.5	37	Winged Elm	10.3
13	American Elm	7.8	38	Persimmon	11.5
14	Willow Oak	11	39	Overcup Oak	7.9
15	Green Ash	12	40	Overcup Oak	3.2
16	Red Maple	9.2	41	Green Ash	7.4
17	Green Ash	10.5	42	Overcup Oak	8.1
18	Swp. Chestnut Oak	9.3	43	Swp. Chestnut Oak	4.0
19	Shagbark Hickory	9.3	44	Beech	2.7
20	Willow Oak	13.6	45	Swp. Chestnut Oak	5.9
21	Sweetgum	8.8	46	Winged Elm	3.0
22	Swp. Chestnut Oak	4.5	47	Winged Elm	4.3
23	Red Maple	13.1	48	Winged Elm	4.6
24	Green Ash	12.5	49	Post Oak	2.69
25	American Elm	8.8	50	Post Oak	6.9

Number 1-10 are in the reference area. Number 11-50 are in the preservation area.

3.4 Conclusion

This site involved the planting of approximately 5 acres of bottomland hardwood forest. There were three plots established throughout the planting area, encompassing all plant communities. The vegetation monitoring revealed an average density of 524 trees per acre, which is well above the minimum 320 trees per acre required by the success criteria.

Fifty trees in the existing Reference, Preservation, and Restoration Areas have been tagged and identified for monitoring to ensure that increased hydrology is not detrimental to these trees.

NCDOT requests that the USACE modify the special conditions regarding vegetation monitoring and success in the following USACE Individual Permits.

Projects Mitigated for at South Buffalo Creek Mitigation Site		
USACE Action ID	TIP No.	Special Conditions
199300243	I-2402D/U-2525A	(j)
199820490	I-2201F	(j)
199820490	I-2201E	(k)

These special conditions should reflect the monitoring strategies and vegetation success described in this report and in the December 3, 1999 letter to USACE regarding South Buffalo Creek Mitigation Site.

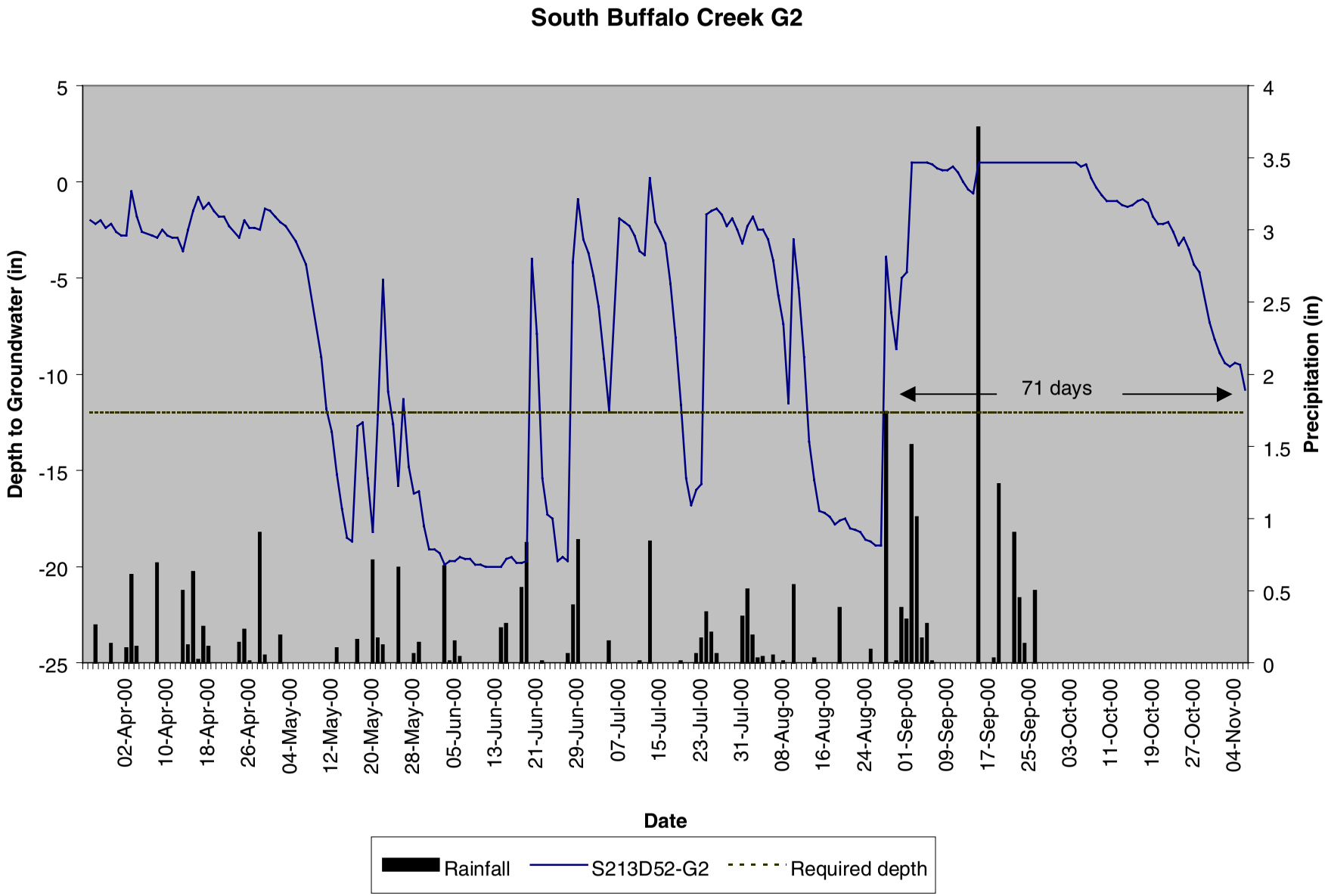
4.0 OVERALL CONCLUSIONS AND RECOMMENDATIONS

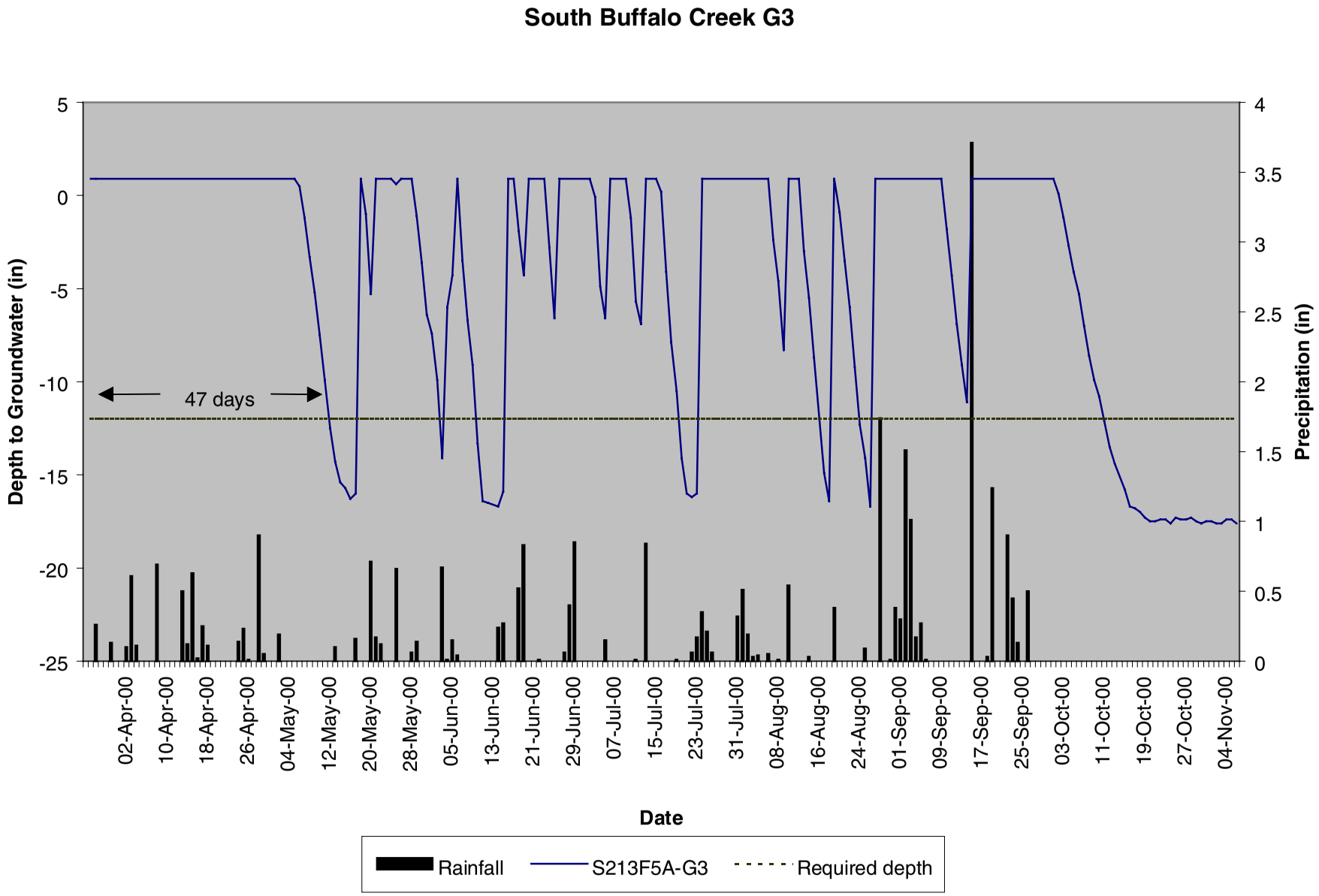
Hydrologic monitoring will continue for the third year in 2001 and vegetation monitoring will continue for the second year at the South Buffalo Creek Mitigation Site. NCDOT plans to continue monitoring existing, mature trees in the restoration and preservation areas of the site in 2001. NCDOT requests that the United States Army Corps of Engineers modify the special conditions regarding vegetation monitoring and success for specific Individual Permits as mentioned in section 3.4 of this report.

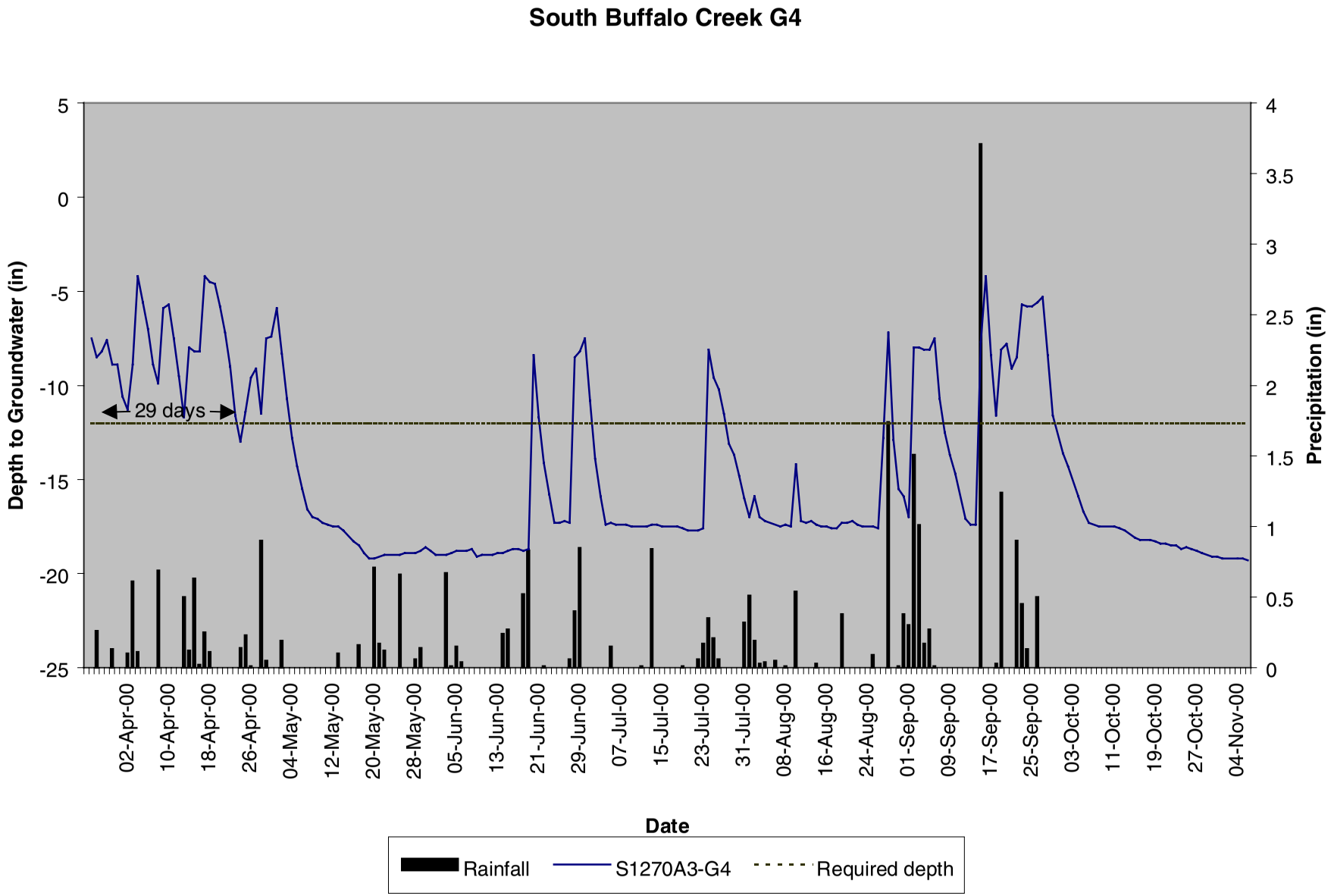
NCDOT also plans to survey gauge elevations in 2001 to facilitate data correlation to actual site conditions. Downloaded data from G10 will be examined, and if deemed necessary, an additional gauge may be installed in the area to replace this gauge.

APPENDIX A

DEPTH TO GROUNDWATER PLOTS


South Buffalo Creek G2
Depth to Groundwater (in)
Precipitation (in)
5
0
-5
-10
-15
-20
-25
4
3.5
3
2.5
2
1.5
1
0.5
0
71 days
02-Apr-00
10-Apr-00
18-Apr-00
26-Apr-00
04-May-00
12-May-00
20-May-00
28-May-00
05-Jun-00
13-Jun-00
21-Jun-00
29-Jun-00
07-Jul-00
15-Jul-00
23-Jul-00
31-Jul-00
08-Aug-00
16-Aug-00
24-Aug-00
01-Sep-00
09-Sep-00
17-Sep-00
25-Sep-00
03-Oct-00
11-Oct-00
19-Oct-00
27-Oct-00
04-Nov-00
Date
Rainfall
S213D52-G2
Required depth


South Buffalo Creek G3
Depth to Groundwater (in)
Precipitation (in)
5
0
-5
-10
-15
-20
-25
4
3.5
3
2.5
2
1.5
1
0.5
0
47 days
02-Apr-00
10-Apr-00
18-Apr-00
26-Apr-00
04-May-00
12-May-00
20-May-00
28-May-00
05-Jun-00
13-Jun-00
21-Jun-00
29-Jun-00
07-Jul-00
15-Jul-00
23-Jul-00
31-Jul-00
08-Aug-00
16-Aug-00
24-Aug-00
01-Sep-00
09-Sep-00
17-Sep-00
25-Sep-00
03-Oct-00
11-Oct-00
19-Oct-00
27-Oct-00
04-Nov-00
Date
Rainfall
S213F5A-G3
Required depth


South Buffalo Creek G4
Depth to Groundwater (in)
Precipitation (in)
5
0
-5
-10
-15
-20
-25
4
3.5
3
2.5
2
1.5
1
0.5
0
29 days
02-Apr-00
10-Apr-00
18-Apr-00
26-Apr-00
04-May-00
12-May-00
20-May-00
28-May-00
05-Jun-00
13-Jun-00
21-Jun-00
29-Jun-00
07-Jul-00
15-Jul-00
23-Jul-00
31-Jul-00
08-Aug-00
16-Aug-00
24-Aug-00
01-Sep-00
09-Sep-00
17-Sep-00
25-Sep-00
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11-Oct-00
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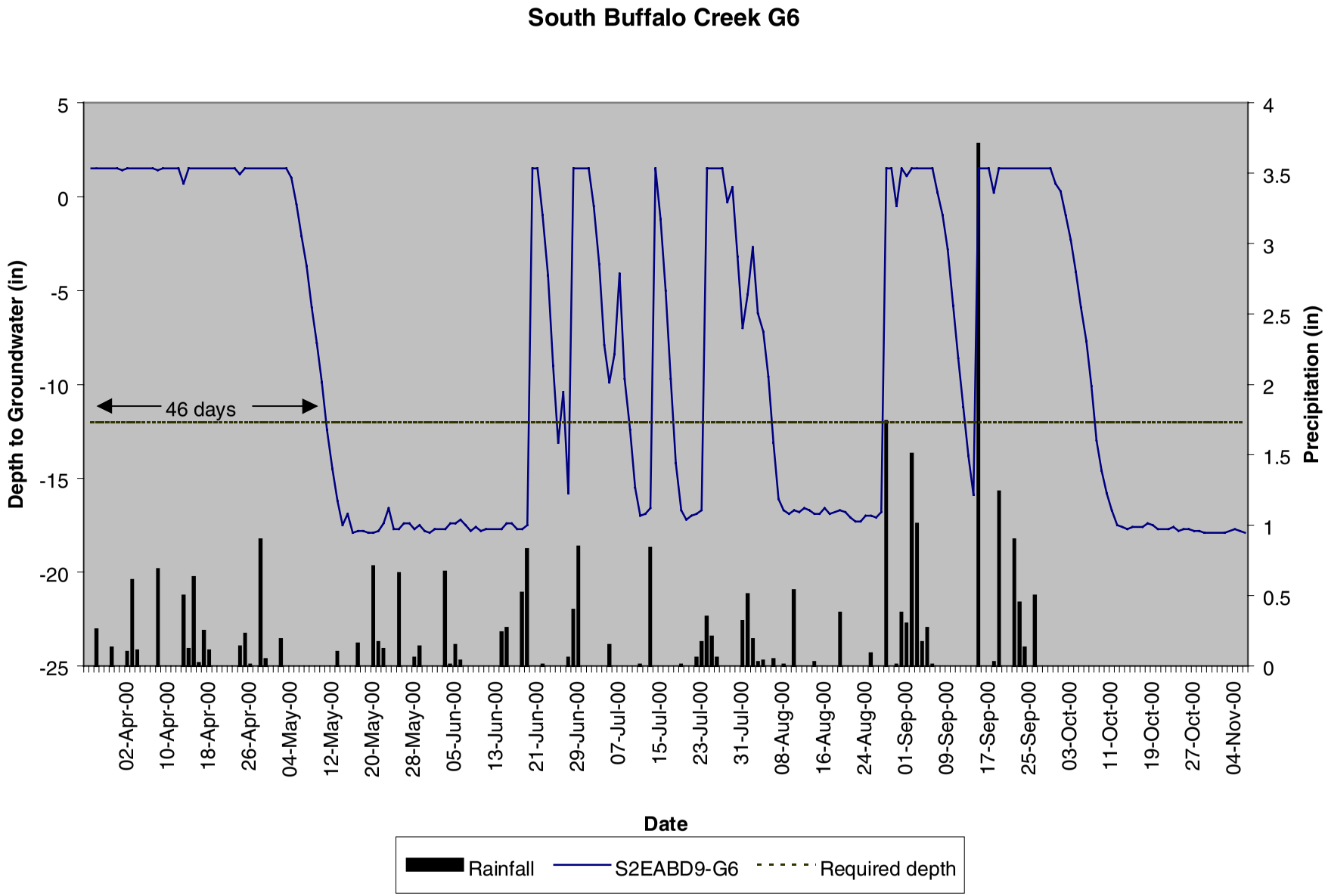
04-Nov-00
Date
Rainfall
S1270A3-G4
Required depth


South Buffalo Creek G6
Depth to Groundwater (in)
Precipitation (in)
5
0
-5
-10
-15
-20
-25
4
3.5
3
2.5
2
1.5
1
0.5
0
46 days
02-Apr-00
10-Apr-00
18-Apr-00
26-Apr-00
04-May-00
12-May-00
20-May-00
28-May-00
05-Jun-00
13-Jun-00
21-Jun-00
29-Jun-00
07-Jul-00
15-Jul-00
23-Jul-00
31-Jul-00
08-Aug-00
16-Aug-00
24-Aug-00
01-Sep-00
09-Sep-00
17-Sep-00
25-Sep-00
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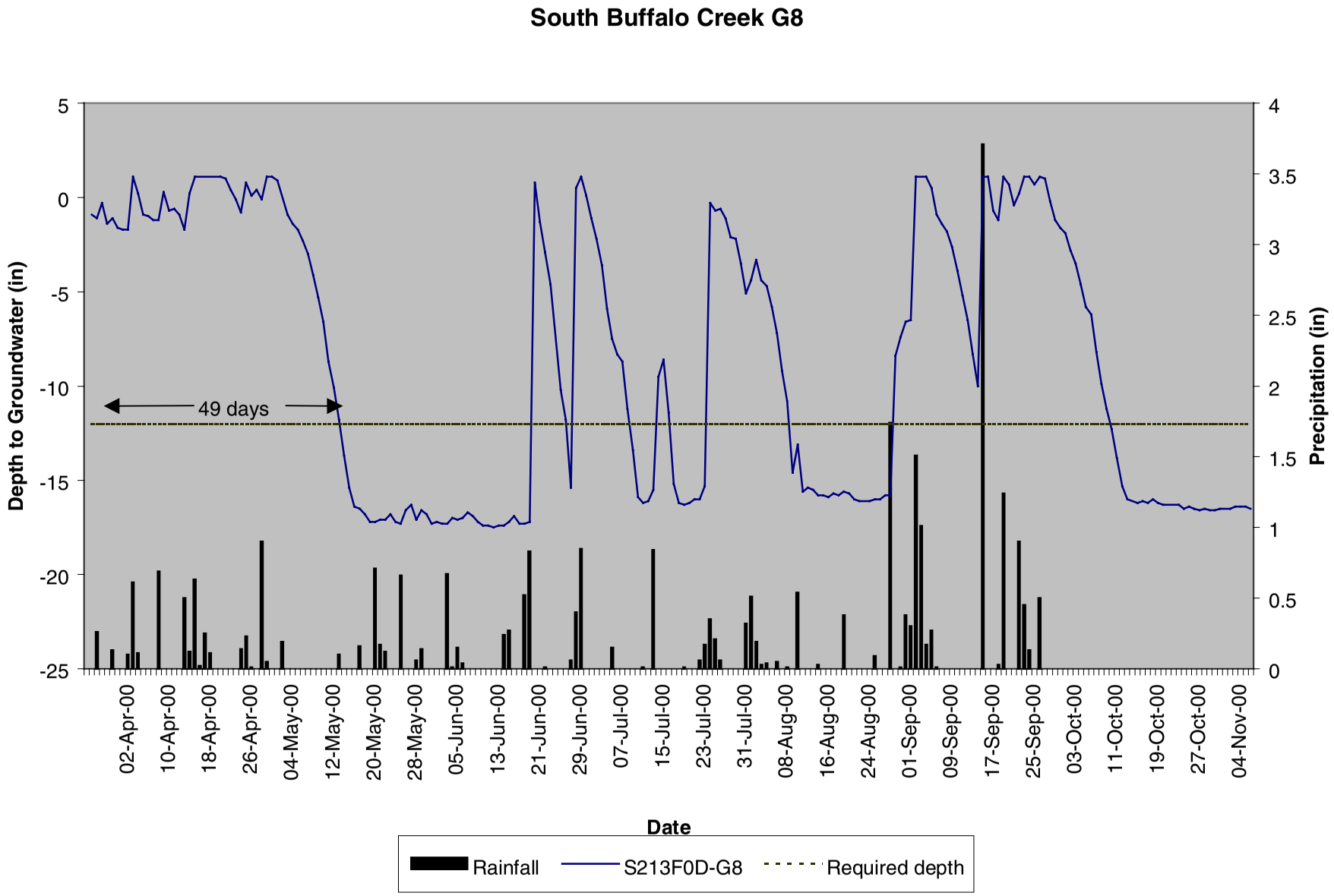
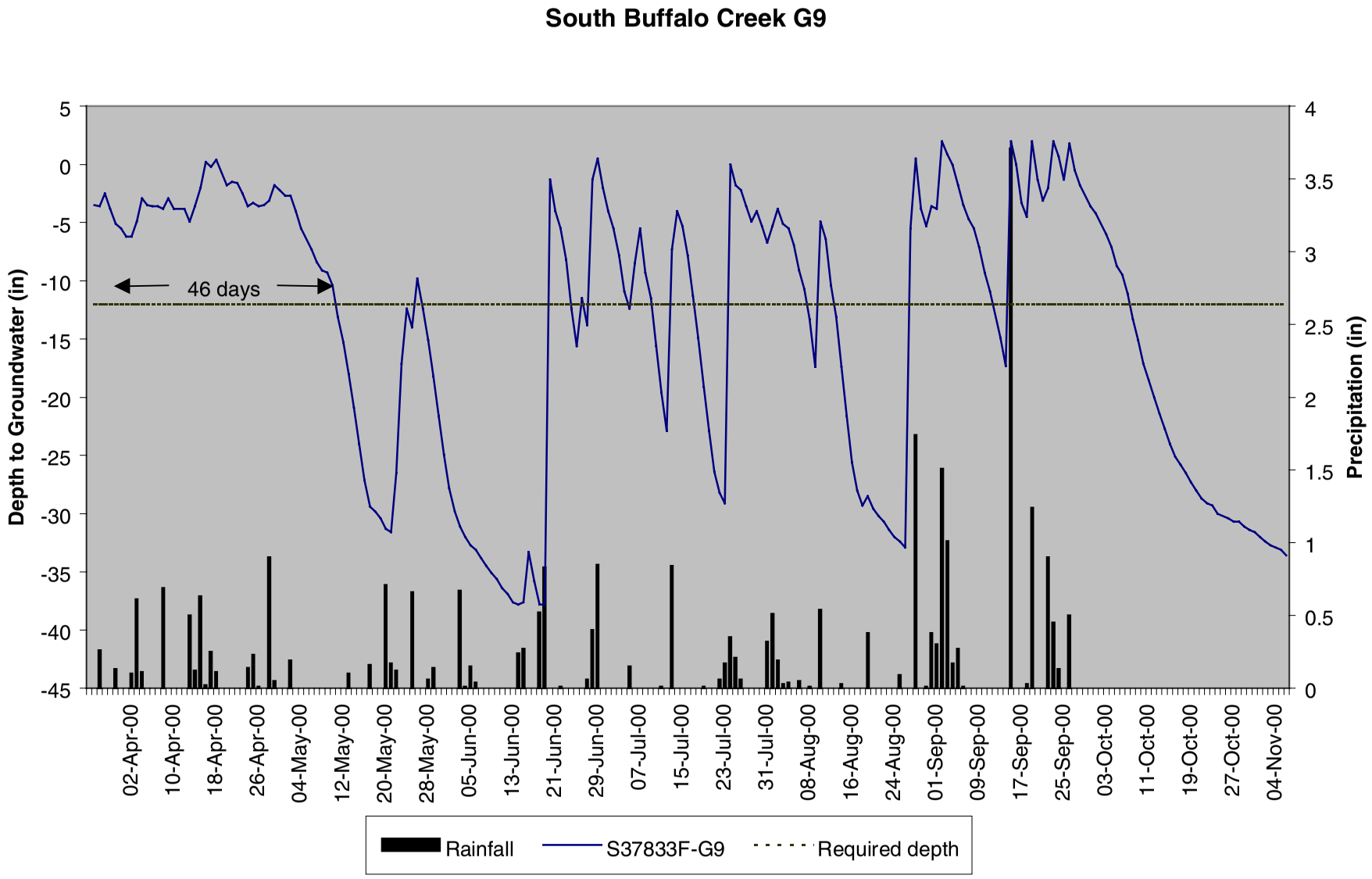
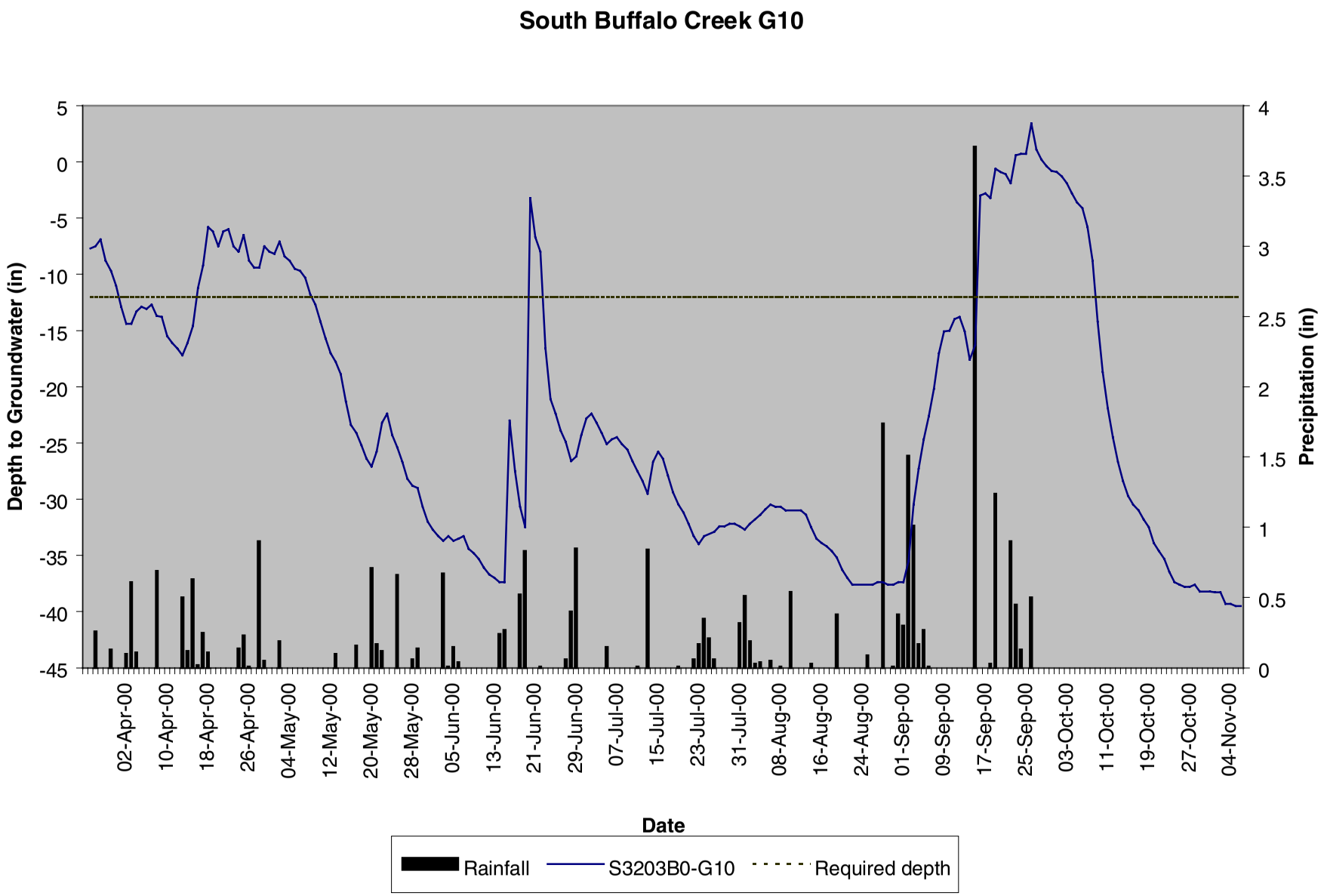
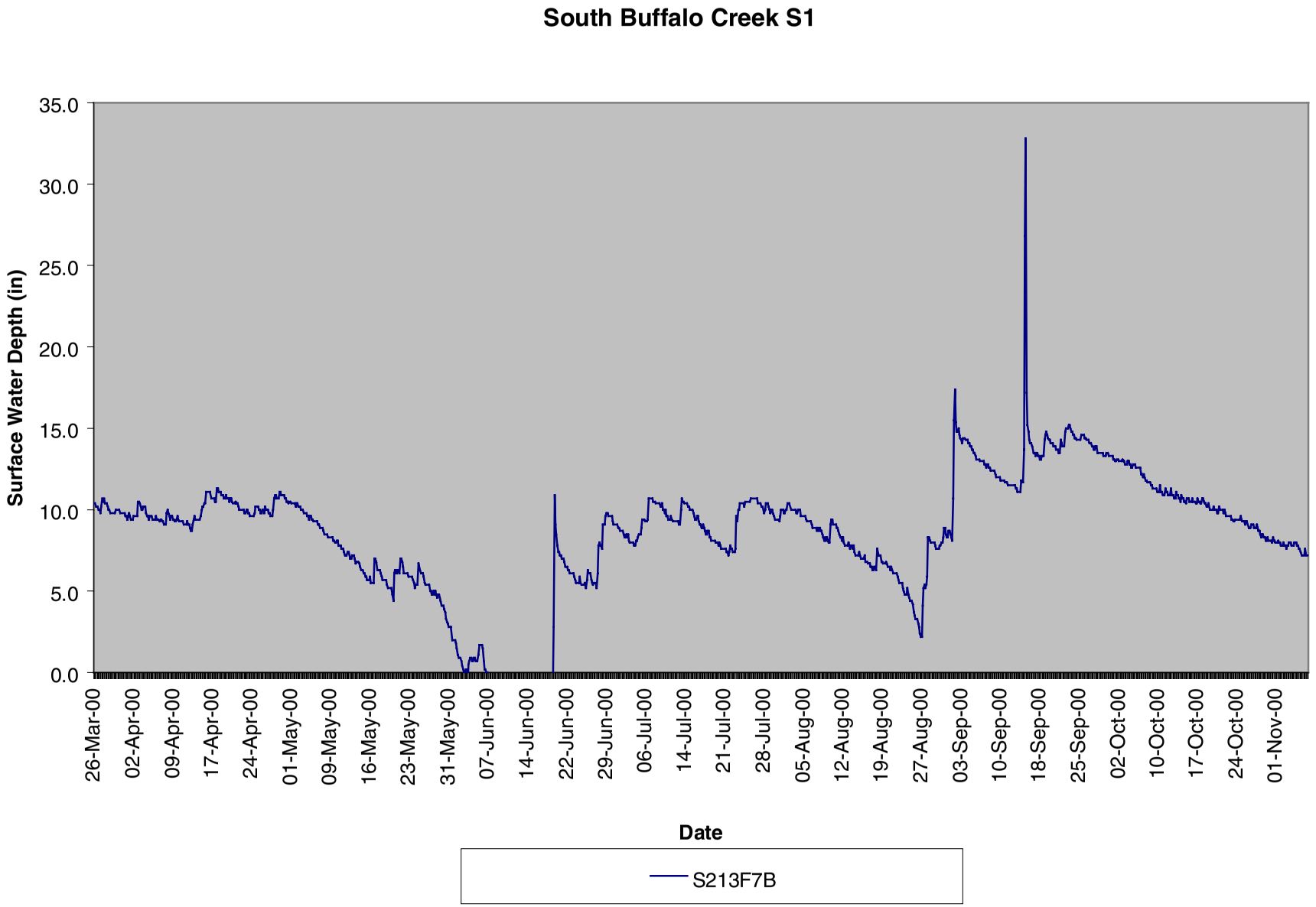
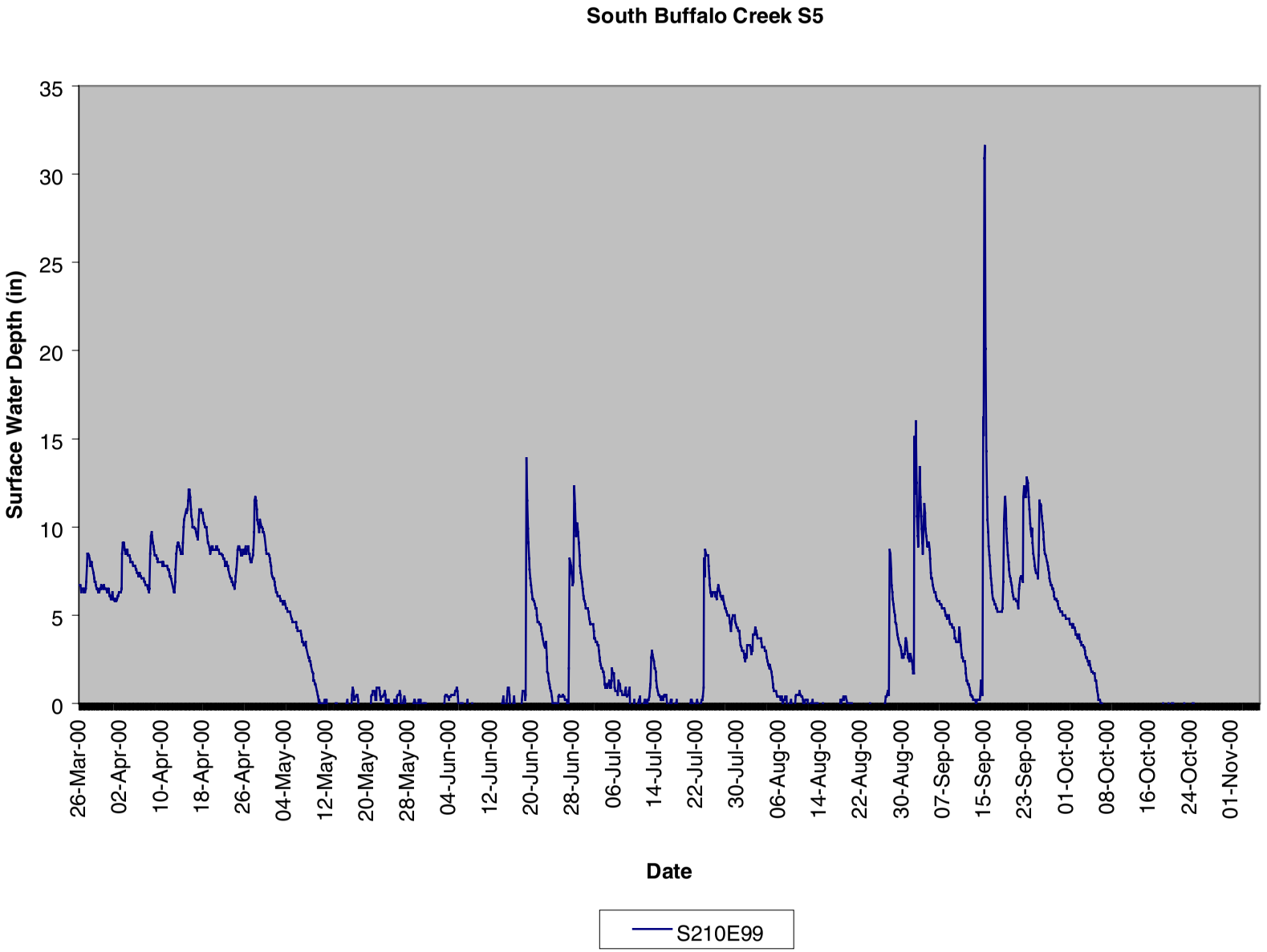
Date
Rainfall
S2EABD9-G6
Required depth


South Buffalo Creek G8
Depth to Groundwater (in)
Precipitation (in)
5
0
-5
-10
-15
-20
-25
4
3.5
3
2.5
2
1.5
1
0.5
0
49 days
02-Apr-00
10-Apr-00
18-Apr-00
26-Apr-00
04-May-00
12-May-00
20-May-00
28-May-00
05-Jun-00
13-Jun-00
21-Jun-00
29-Jun-00
07-Jul-00
15-Jul-00
23-Jul-00
31-Jul-00
08-Aug-00
16-Aug-00
24-Aug-00
01-Sep-00
09-Sep-00
17-Sep-00
25-Sep-00
03-Oct-00
11-Oct-00
19-Oct-00
27-Oct-00
04-Nov-00
Date
Rainfall
S213F0D-G8
Required depth


South Buffalo Creek G9
Depth to Groundwater (in)
Precipitation (in)
46 days
5
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
4
3.5
3
2.5
2
1.5
1
0.5
0
02-Apr-00
10-Apr-00
18-Apr-00
26-Apr-00
04-May-00
12-May-00
20-May-00
28-May-00
05-Jun-00
13-Jun-00
21-Jun-00
29-Jun-00
07-Jul-00
15-Jul-00
23-Jul-00
31-Jul-00
08-Aug-00
16-Aug-00
24-Aug-00
01-Sep-00
09-Sep-00
17-Sep-00
25-Sep-00
03-Oct-00
11-Oct-00
19-Oct-00
27-Oct-00
04-Nov-00
Rainfall
S37833F-G9
Required depth


South Buffalo Creek G10
Depth to Groundwater (in)
Precipitation (in)
5
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
4
3.5
3
2.5
2
1.5
1
0.5
0
02-Apr-00
10-Apr-00
18-Apr-00
26-Apr-00
04-May-00
12-May-00
20-May-00
28-May-00
05-Jun-00
13-Jun-00
21-Jun-00
29-Jun-00
07-Jul-00
15-Jul-00
23-Jul-00
31-Jul-00
08-Aug-00
16-Aug-00
24-Aug-00
01-Sep-00
09-Sep-00
17-Sep-00
25-Sep-00
03-Oct-00
11-Oct-00
19-Oct-00
27-Oct-00
04-Nov-00
Date
Rainfall
S3203B0-G10
Required depth


South Buffalo Creek S1
Surface Water Depth (in)
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
26-Mar-00
02-Apr-00
09-Apr-00
17-Apr-00
24-Apr-00
01-May-00
09-May-00
16-May-00
23-May-00
31-May-00
07-Jun-00
14-Jun-00
22-Jun-00
29-Jun-00
06-Jul-00
14-Jul-00
21-Jul-00
28-Jul-00
05-Aug-00
12-Aug-00
19-Aug-00
27-Aug-00
03-Sep-00
10-Sep-00
18-Sep-00
25-Sep-00
02-Oct-00
10-Oct-00
17-Oct-00
24-Oct-00
01-Nov-00
Date
S213F7B


South Buffalo Creek S5
Surface Water Depth (in)
35
30
25
20
15
10
5
0
26-Mar-00
02-Apr-00
10-Apr-00
18-Apr-00
26-Apr-00
04-May-00
12-May-00
20-May-00
28-May-00
04-Jun-00
12-Jun-00
20-Jun-00
28-Jun-00
06-Jul-00
14-Jul-00
22-Jul-00
30-Jul-00
06-Aug-00
14-Aug-00
22-Aug-00
30-Aug-00
07-Sep-00
15-Sep-00
23-Sep-00
01-Oct-00
08-Oct-00
16-Oct-00
24-Oct-00
01-Nov-00
Date
S210E99

APPENDIX B

SITE PHOTOS

Photo 1

Photo 2

Photo 3

Photo 4